Application of IKONOS Imagery to Analysis of Intermodal Transportation Corridors in Los Angeles

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TOPICS

- Project Overview
- Geometry Analysis of IKONOS Imagery Used
- Recent Research Results Developing a Corridor Analysis Tool
  - Intermodal Connectors
  - Satellite Data Analysis
- Future Analysis

Project Overview

- The Project Tasks Include:
  1. Obtaining, Combining and Evaluating Best Remote Sensing Tools for Analysis of Intermodal Connectors
  2. Correlating with Nationally-Available Ground-Based Data (Land Use/Land Cover, Transportation, Census, Zoning, Address Match)
  3. Evaluation of Resultant Data in Conjunction with GIS
  4. Preparation of a *Corridor Analysis Tool* Report which Outlines Optimum Approaches to Analyzing Intermodal Connectors With Remote Sensing and Associated Tools
- Progress to Date:
  - Tasks 1. & 2. Complete
  - *Corridor Analysis Tool* to Provide Road Connector and Land Use Information to the Highway Capacity Manual (2000 ed).

Intermodal Connectors Under Study

- Carson Transshipment Yard Intermodal Facility
  - Routes already planned from rail container facility to I-710 freeway
  - Site used for technique development
- Washington Blvd Intermodal Facility
  - Applying techniques developed and validated at Carson Yard
  - Will study alternative routes available to I-710 as Inputs to Highway Capacity Manual

Satellite Data Analysis

- IKONOS Data Geometry Analysis
  - Cartographic Suitability for Integration with GIS
- Multispectral Land Use / Land Cover Classification
  - ASTER 15m multispectral analysis for land use classification
  - IKONOS multi-resolution multispectral classification
    - 16m, 12m, 8m, 4m resolutions
- IKONOS Data Enhancement
  - 4m RGB and 1m panchromatic/grayscale Combination
  - Development of 1m color using ISH conversion
  - End product can be used for multispectral classification
- *Feature Analyst* Multispectral Analysis
  - Container classification
  - Roof top classification

Geometry Analysis of Los Angeles IKONOS Imagery

IKONOS 1 Meter Panchromatic and 4 Meter MSS Imagery; ALAMEDA CORRIDOR (Los Angeles to San Pedro)

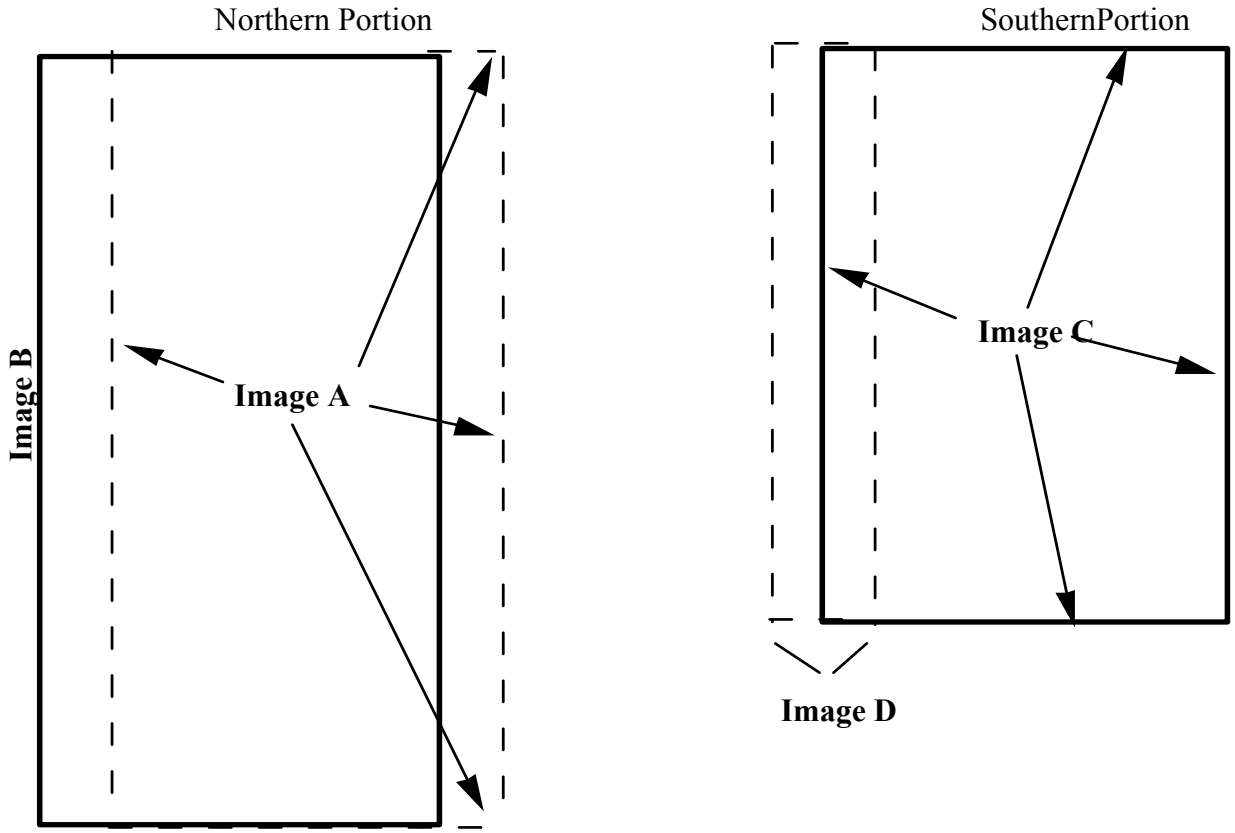


Image A - 23AUG01

Image B - 26AUG01

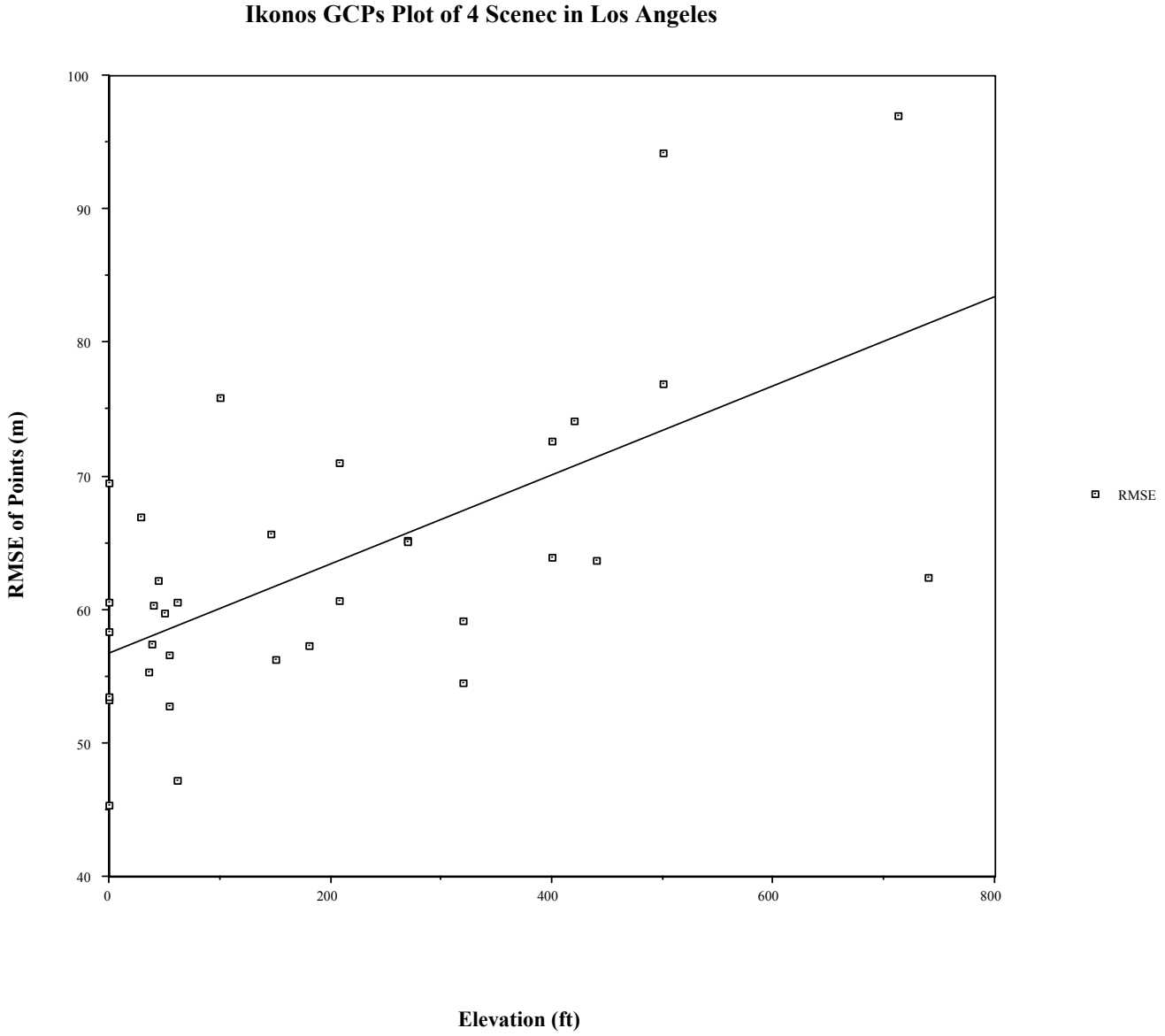
Image C - 17SEP00

Image D - 19DEC00

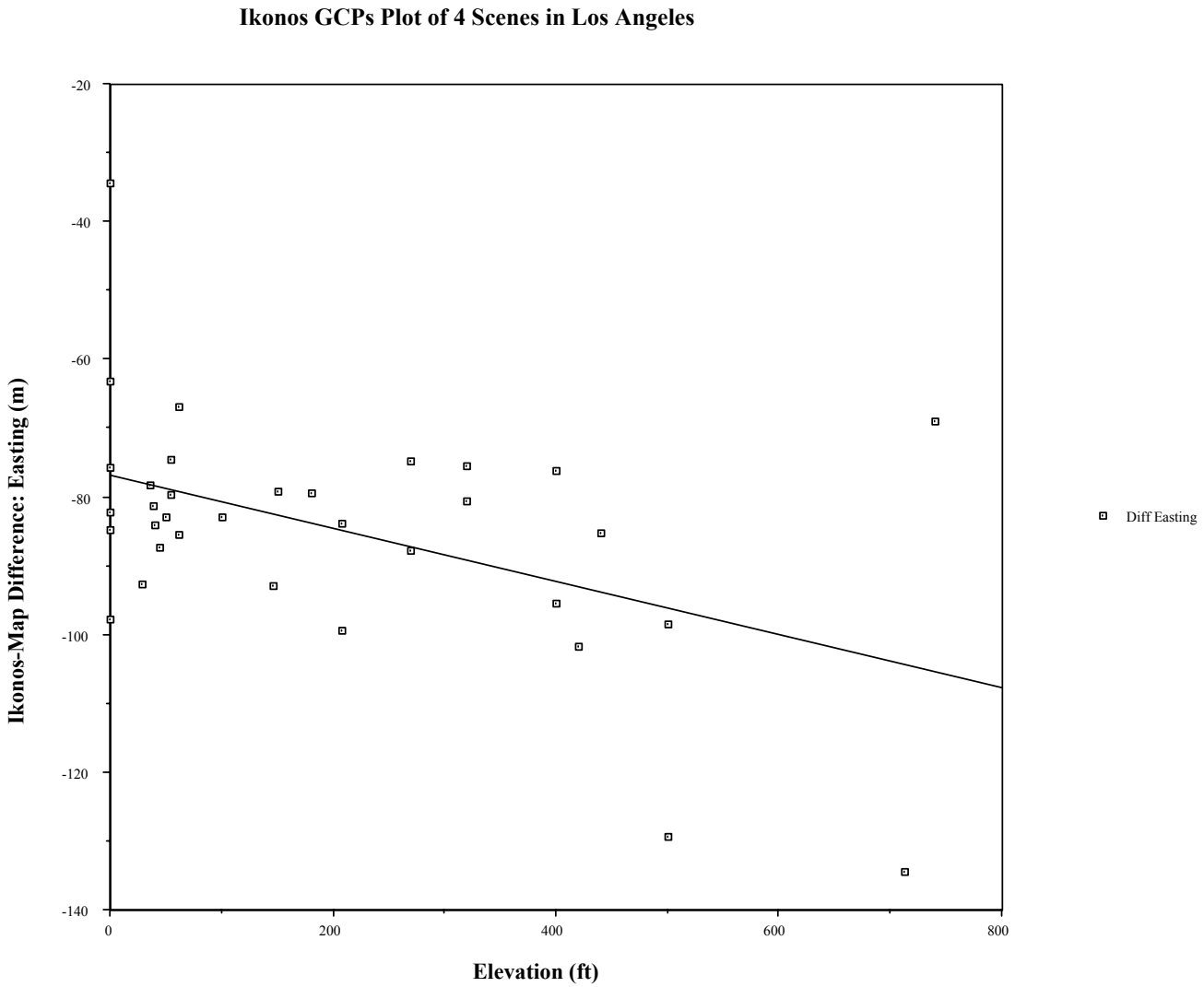
IKONOS Scenes of Los Angeles Geometry Analysis (cont)

Measurement	Image-A, NE 23 Aug 2001	Image-B, NW 26 Aug 2001	Image-C, SE 17 Sept 2000	Image-D, SW 19 Dec 2000
Collection Azimuth	101.11 deg	200.25 deg	232.19 deg	166.87 deg
Collection Elevation	73.44 deg	73.97 deg	69.23 deg	61.89 deg
RMSE All 72 Points IKONOS vs Map	65.00m	65.00m	59.24m	57.75m
Difference All 72 Pts Easting IKONOS-Map	-96.76m	-85.43m	-83.29m	-72.99m
Difference All 72 Pts Northing IKONOS-Map	27.25m	29.09m	6.83m	23.24m
Difference 12 Pts Near Image Edge Easting IKONOS-Map	-85.03m	-82.40m	-78.32m	-78.25m
Difference 11 Pts Far Image Edge Easting IKONOS-Map	-105.13m	-81.15m	-90.16m	-80.41m
Difference 12 Pts Near Image Edge RMSE IKONOS-Map	68.89m	63.93m	55.48m	60.30m
Difference 11 Pts Far Image Edge RMSE IKONOS-Map	75.79m	62.08m	64.02m	57.03m

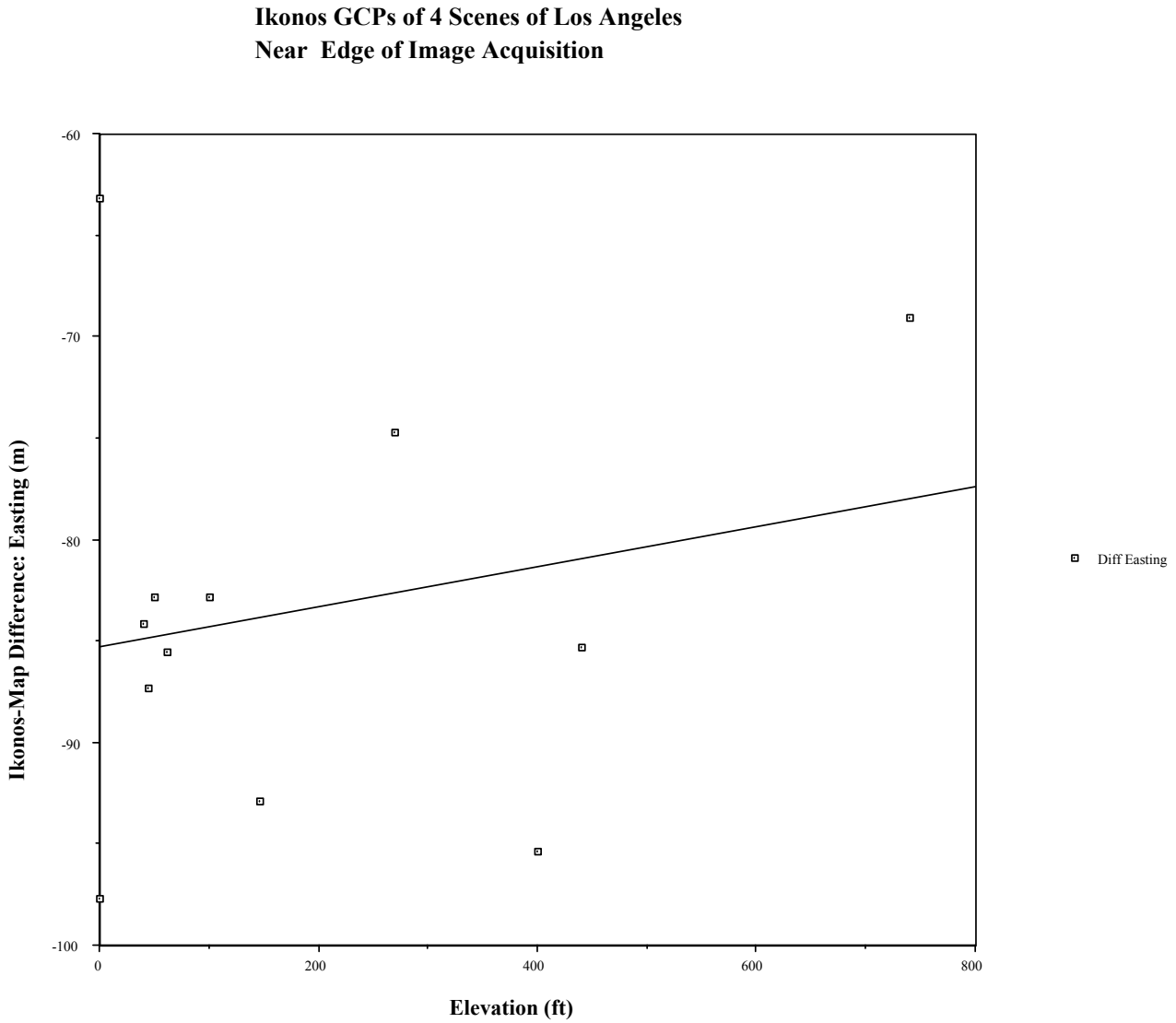
IKONOS Scenes of Los Angeles Geometry Analysis (cont)



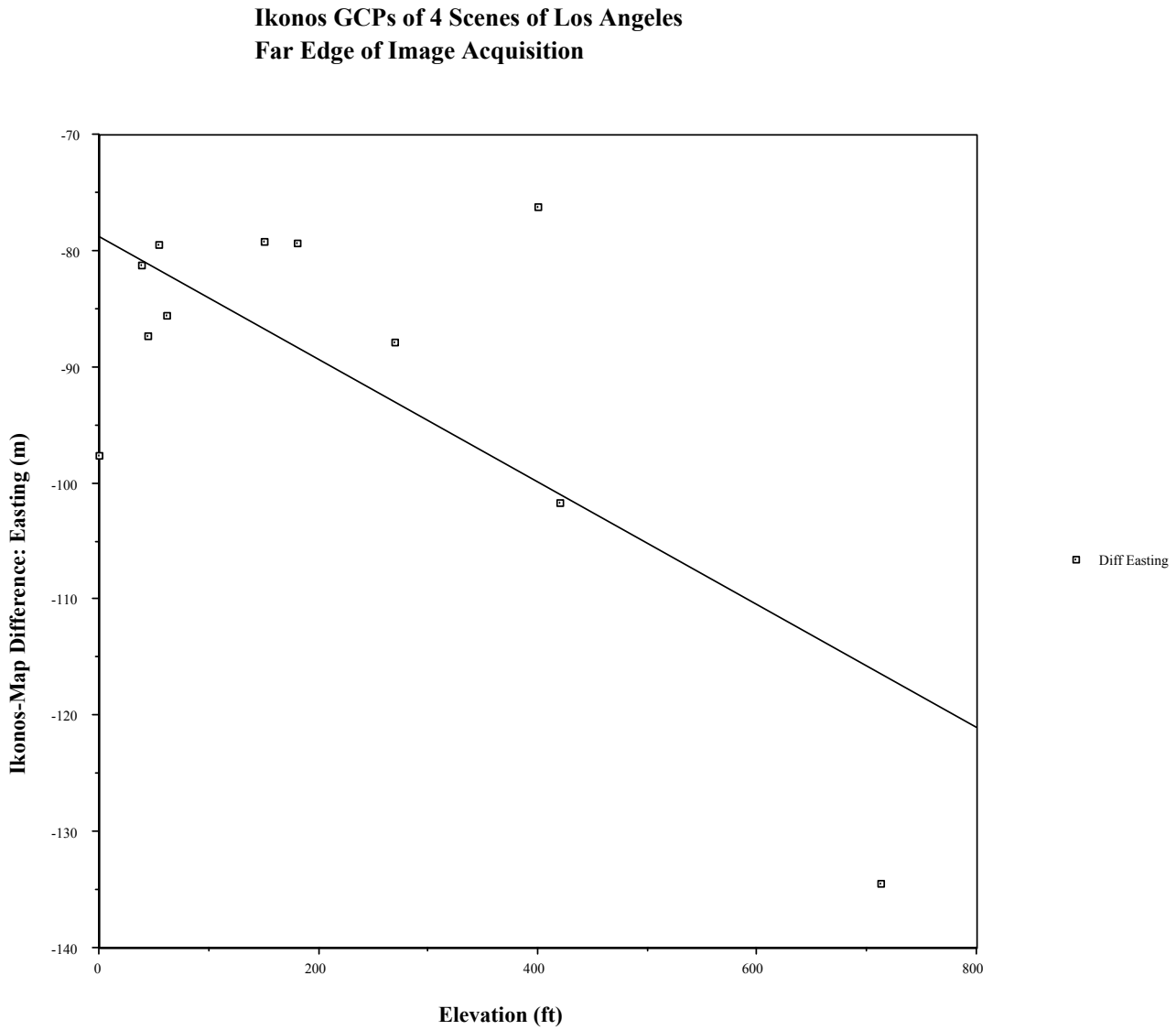
IKONOS Scenes of Los Angeles Geometry Analysis (cont)



IKONOS Scenes of Los Angeles Geometry Analysis (cont)



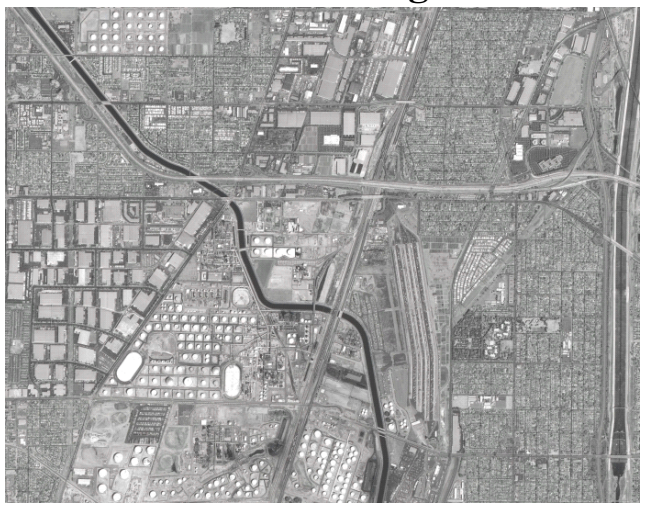
IKONOS Scenes of Los Angeles Geometry Analysis (cont)



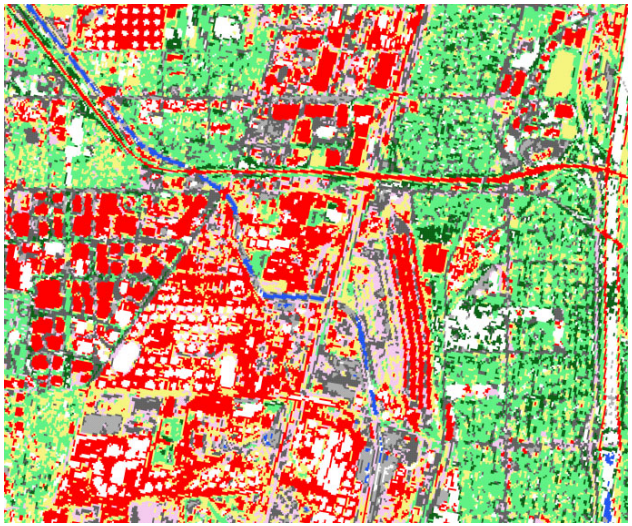
ASTER & IKONOS Imagery Merge, Carson City, Los Angeles County

ASTER Image 15m

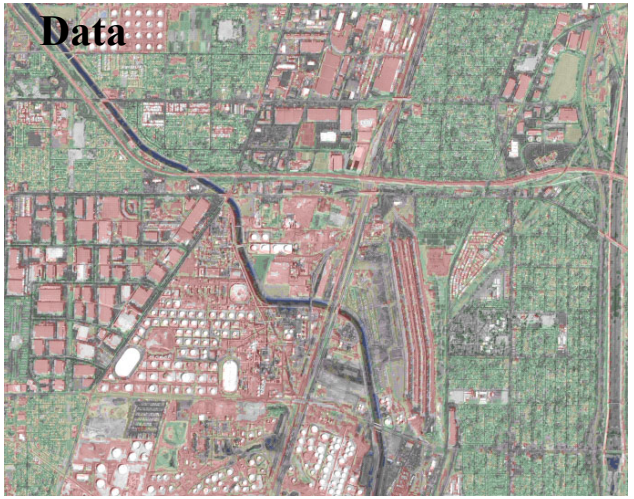
IKONOS Image 1m



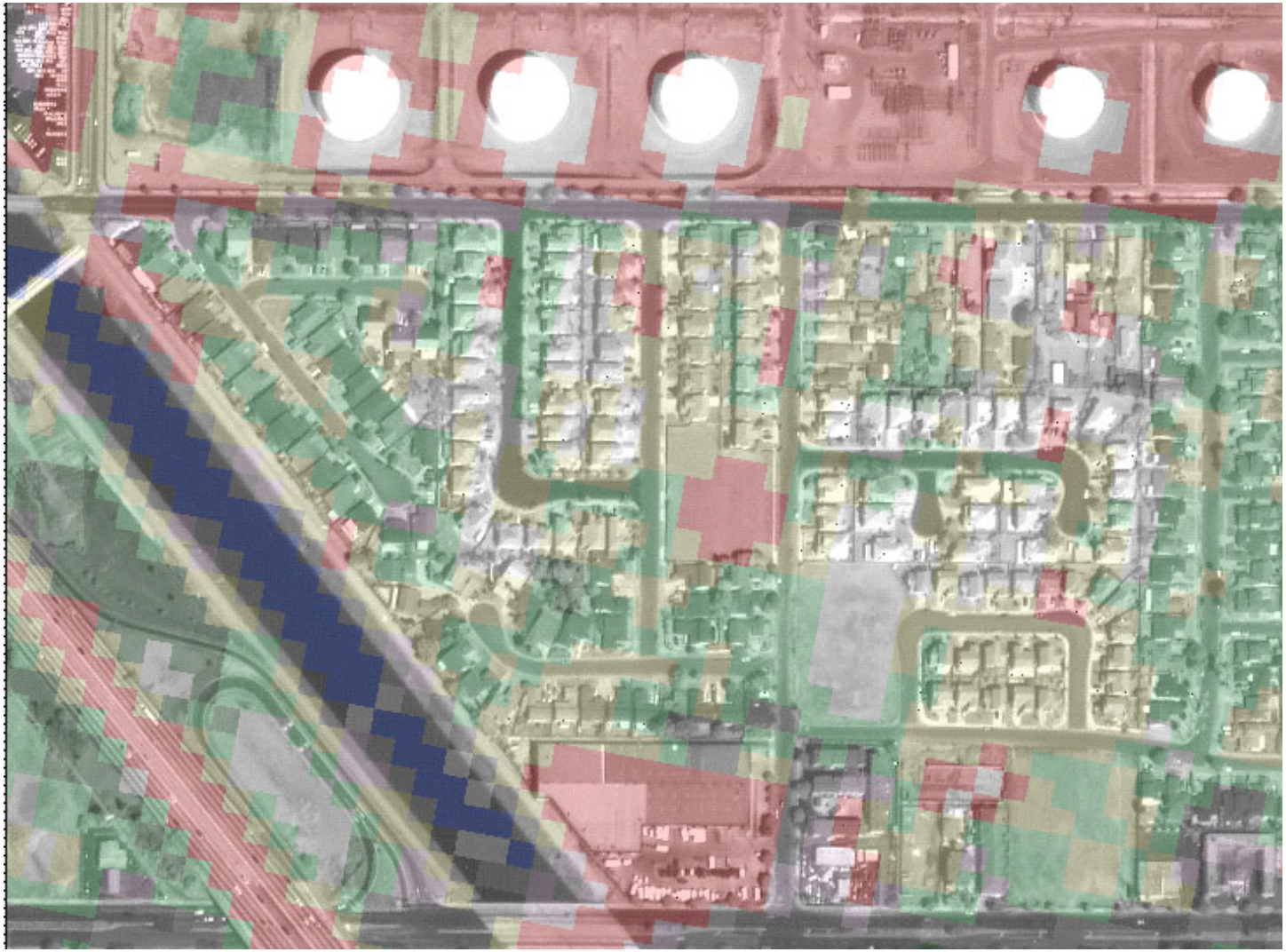
ASTER Multispectral Classification 15m



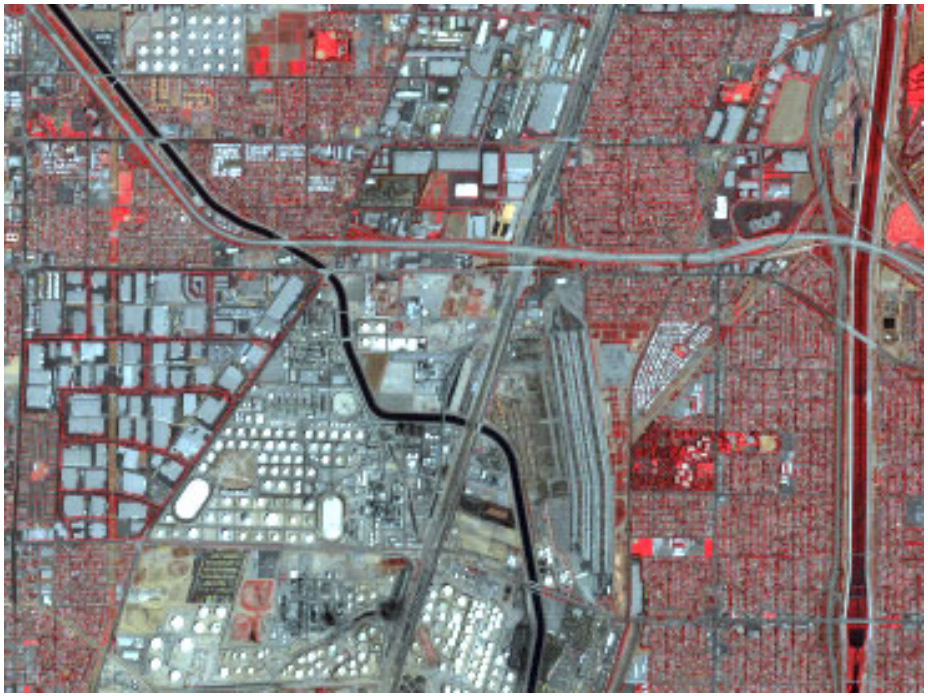
Fused ASTER & IKONOS Data

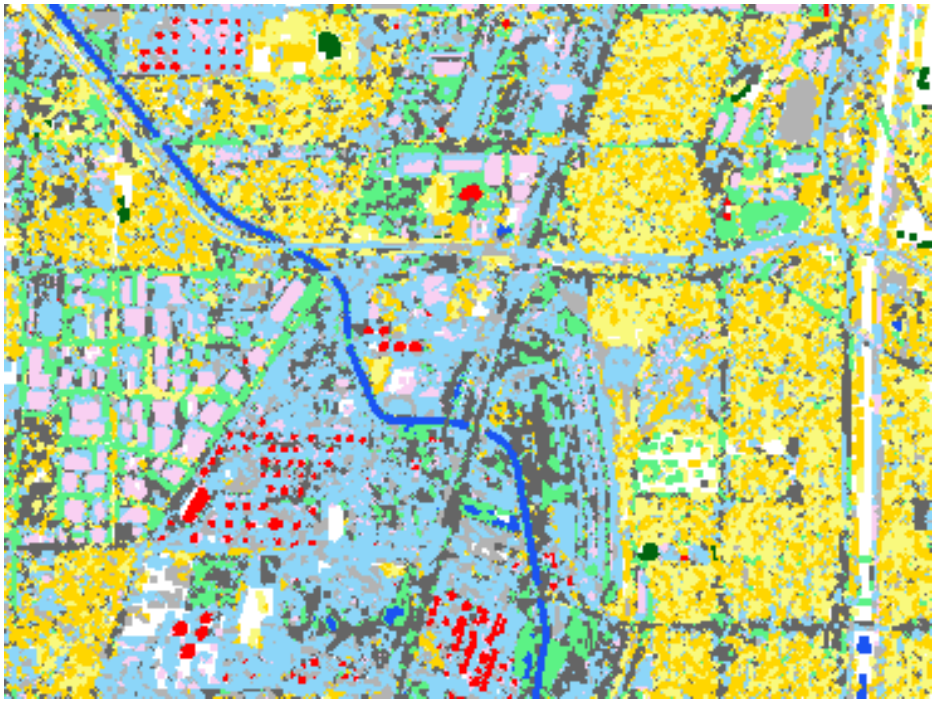


ASTER & IKONOS Imagery Merge Detail, Carson City, Los Angeles County



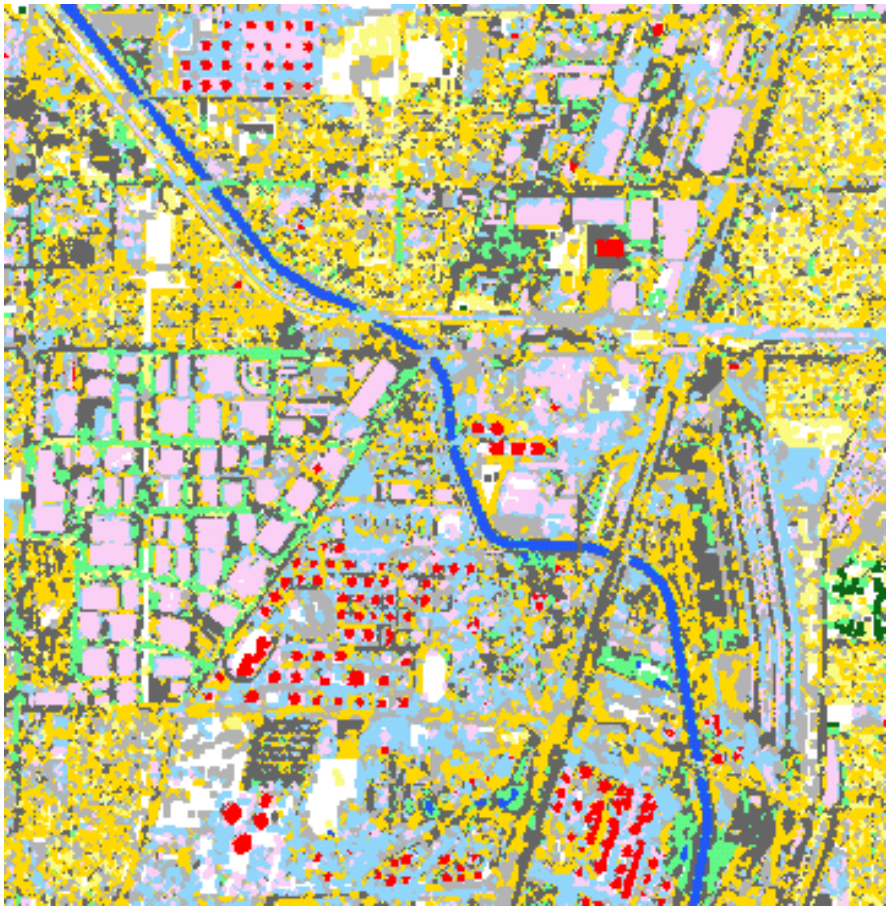
IKONOS CLASSIFICATION
16m Resampled Resolution
CARSON, CALIFORNIA





- Good Residential vs. Commercial separation (Yellows vs. Blue/Pink)
- Marginal Residential Sub-classes (Yellow; Yellow-Orange)
- Classes generally define “Land Use” rather than “Land Cover”

IKONOS CLASSIFICATION
12m Resampled Resolution
CARSON, CALIFORNIA

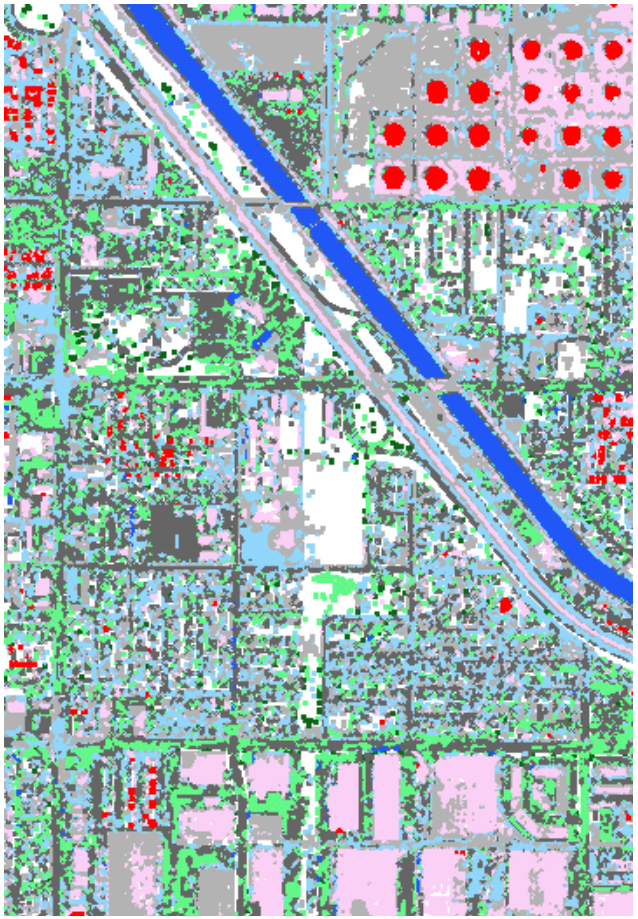


- Poor Residential vs. Commercial separation (Yellows vs. Blue/Pink)
- Very Poor Residential Sub-classes (Yellow; Yellow-Orange)
- Classes generally define the “Land Cover” surface expression.

IKONOS CLASSIFICATION
8m Resampled Resolution
CARSON, CALIFORNIA

- Little Residential vs. Commercial separation (Yellows vs. Blue/Pink)
- No Residential Sub-classes; Individual features begin to dominate.
- Classes are “Land Cover” surface expression.

IKONOS CLASSIFICATION
4m Multispectral Data
CARSON, CALIFORNIA

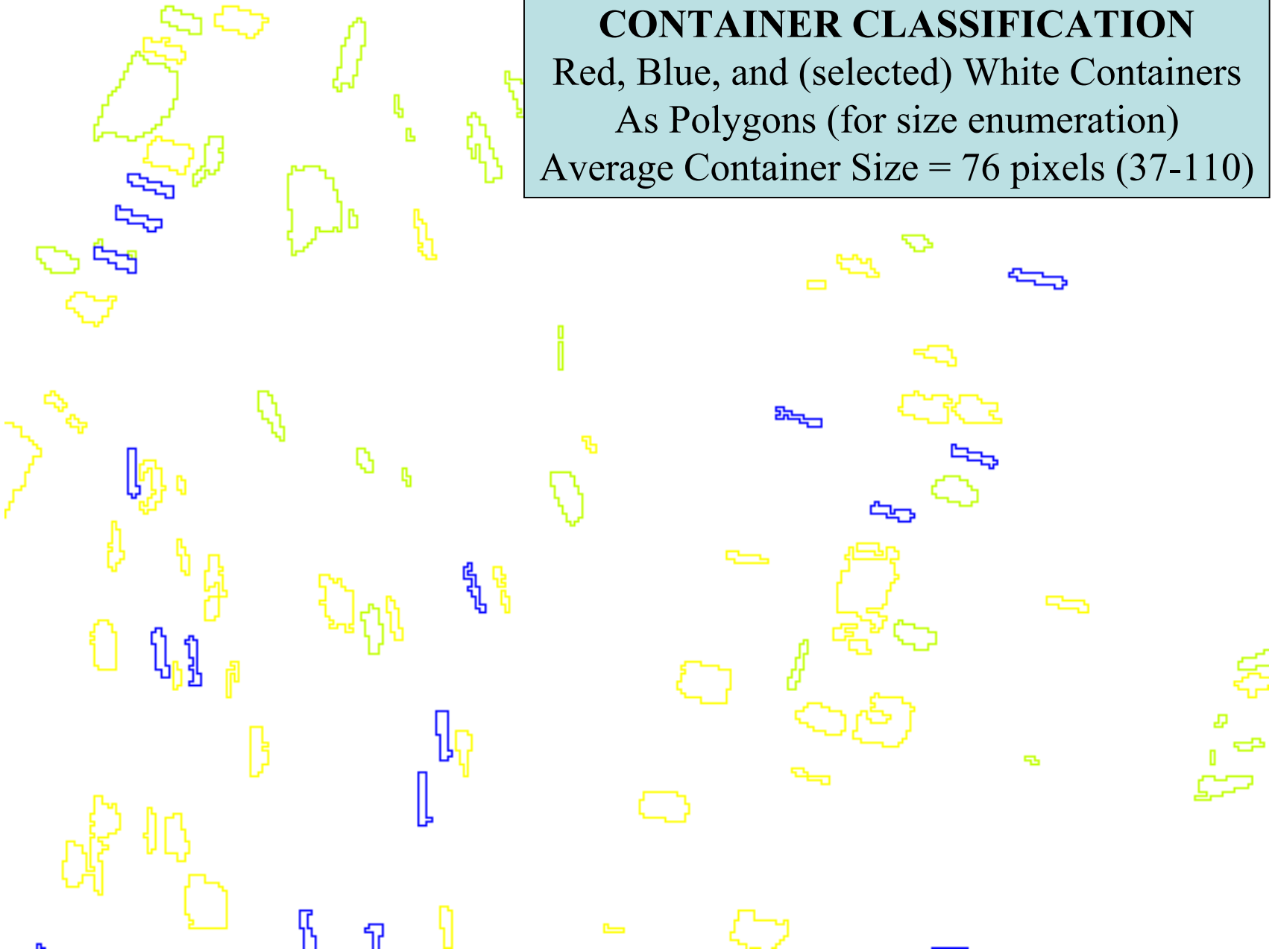


- No Residential vs. Commercial separation; No “Land Use” Classes.
- Local object/features show high resolution and detail.
- Classes are “Land Cover” surface expression.

FEATURE ANALYST (FA) CLASSIFICATION
Carson Transshipment Yards & Vicinity, Los Angeles

- FA is a Spectral and Spatial/Contextual Image Classifier.
- Developed and Marketed by Visual Learning Systems, Inc. (VLS).
- FA designed as a "plug-in" in ArcView (other host sw pending).
- Tested / Demonstrated Applications:
  - Shipping Container Classification/Discrimination
  - Residential Roof Top Classification/Discrimination
- Conclusions:
  - FA is a Powerful and Effective image classifier.
  - Training set preparation requires Experienced Personnel.
  - FA can be an Effective Alternative to Manual Classification.
  - Classified polygons can be coded with Symbol/Icons for Numerical Calculation.
  - Classified Polygons can also be Summed (pixel count) for Identification from multiple Containers (Average=76 pixels)
  - Excellent tools for addition/subtraction classification corrections.


CONTAINER CLASSIFICATION
Red, Blue, and (selected) White Containers
With Symbol/Icons on Red Containers (Red Dots)



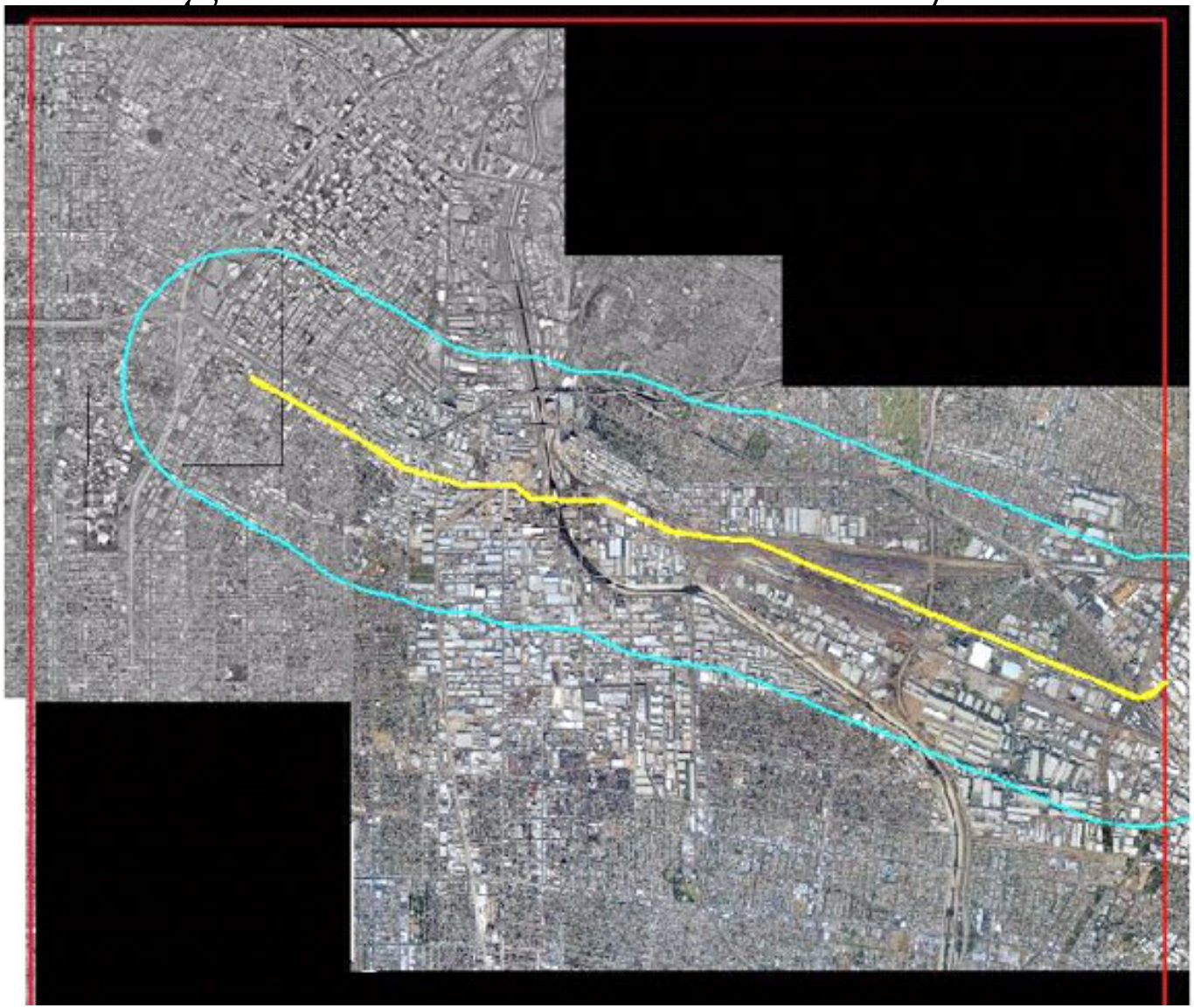
CONTAINER CLASSIFICATION
Red, Blue, and (selected) White Containers
As Polygons (for size enumeration)
Average Container Size = 76 pixels (37-110)

ROOF TOP CLASSIFICATION
Red Roof Tops (Red Polygons)
Brown Roof Tops (Yellow Polygons)

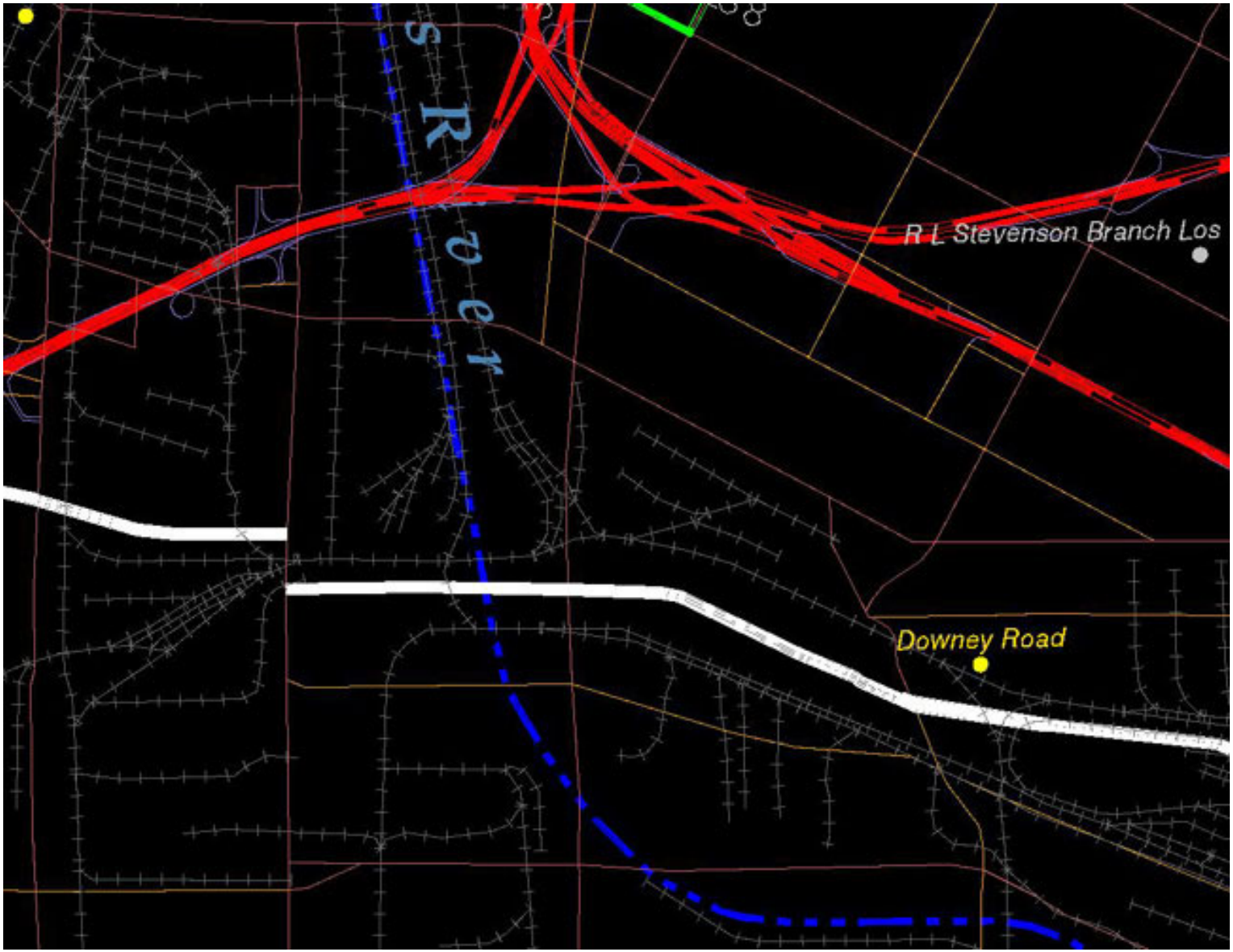
Current Analysis

- Goal: “Corridor Analysis Tool Depends on Nationally Available Datasets”
- Washington Blvd Corridor Study
  - Orthorectification of IKONOS Imagery & GIS Integration
  - Interface with Census, Economic and Transportation Data
  - Route Planning Detail with High-Resolution Aerial Photography
  - Modelling via Interface with Highway Capacity Manual

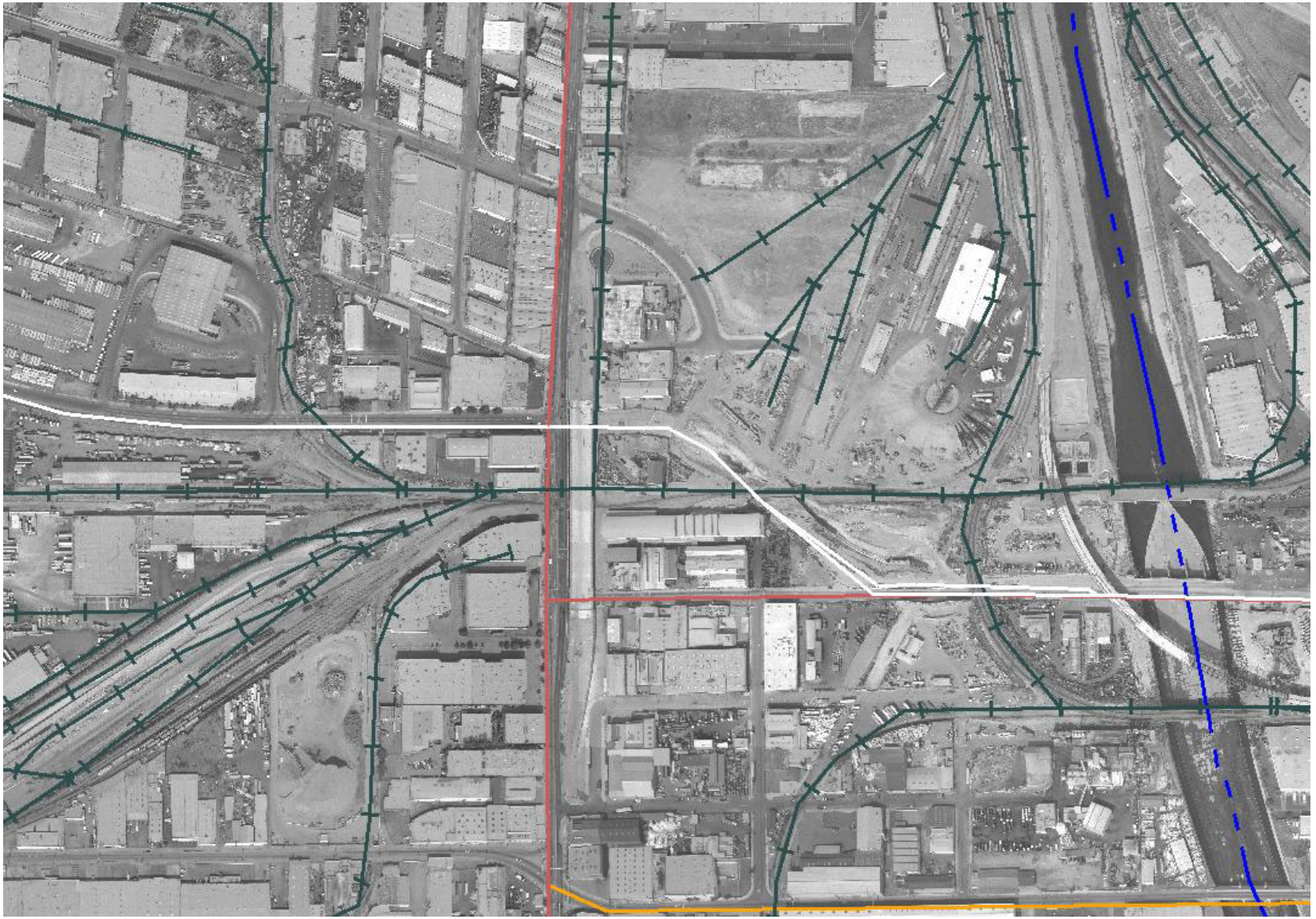
Washington Blvd Corridor Analysis Area



Washington Blvd Vector GIS Data (sample)

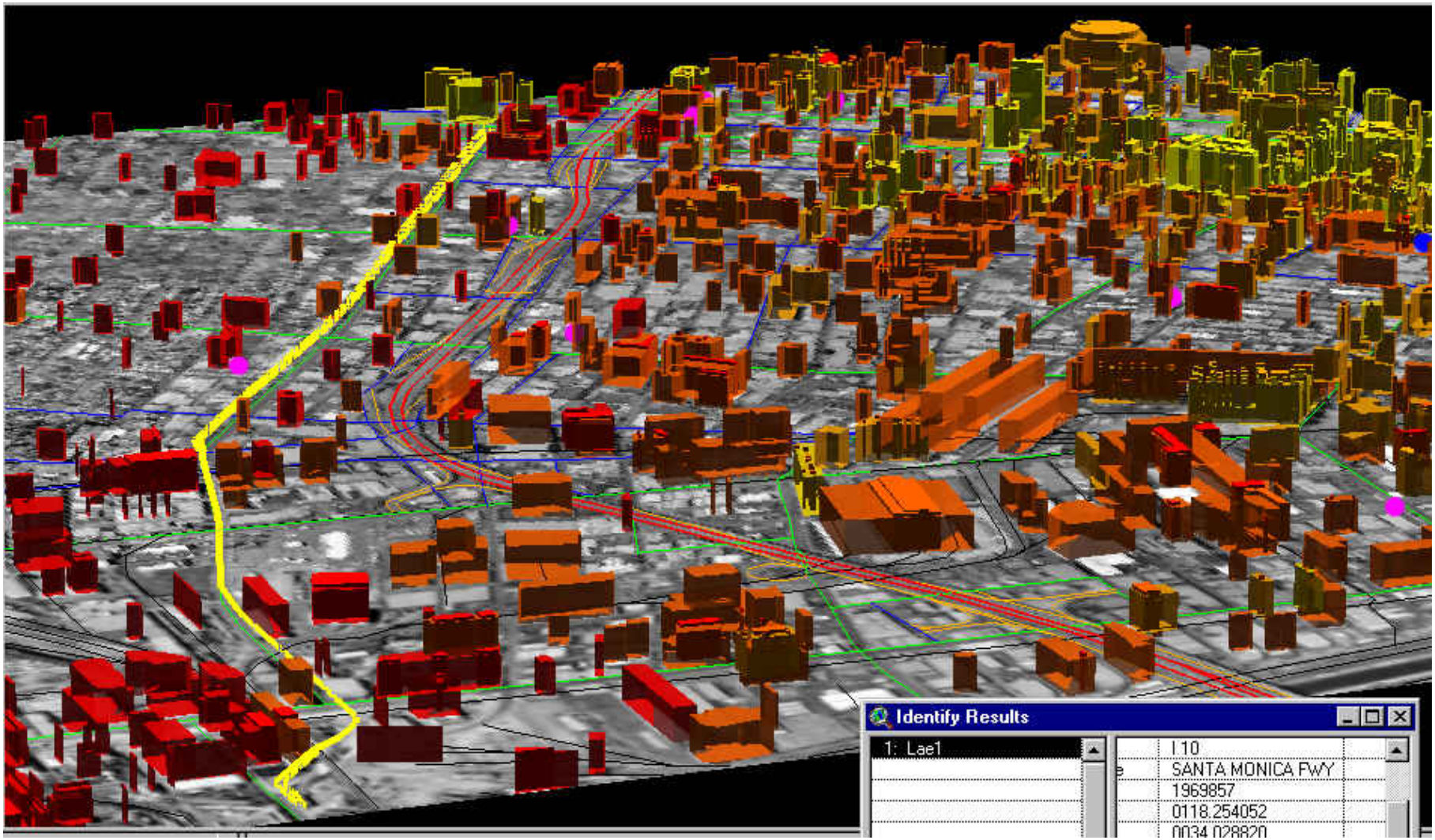


Washington Blvd (sample) with GIS Vector Overlays



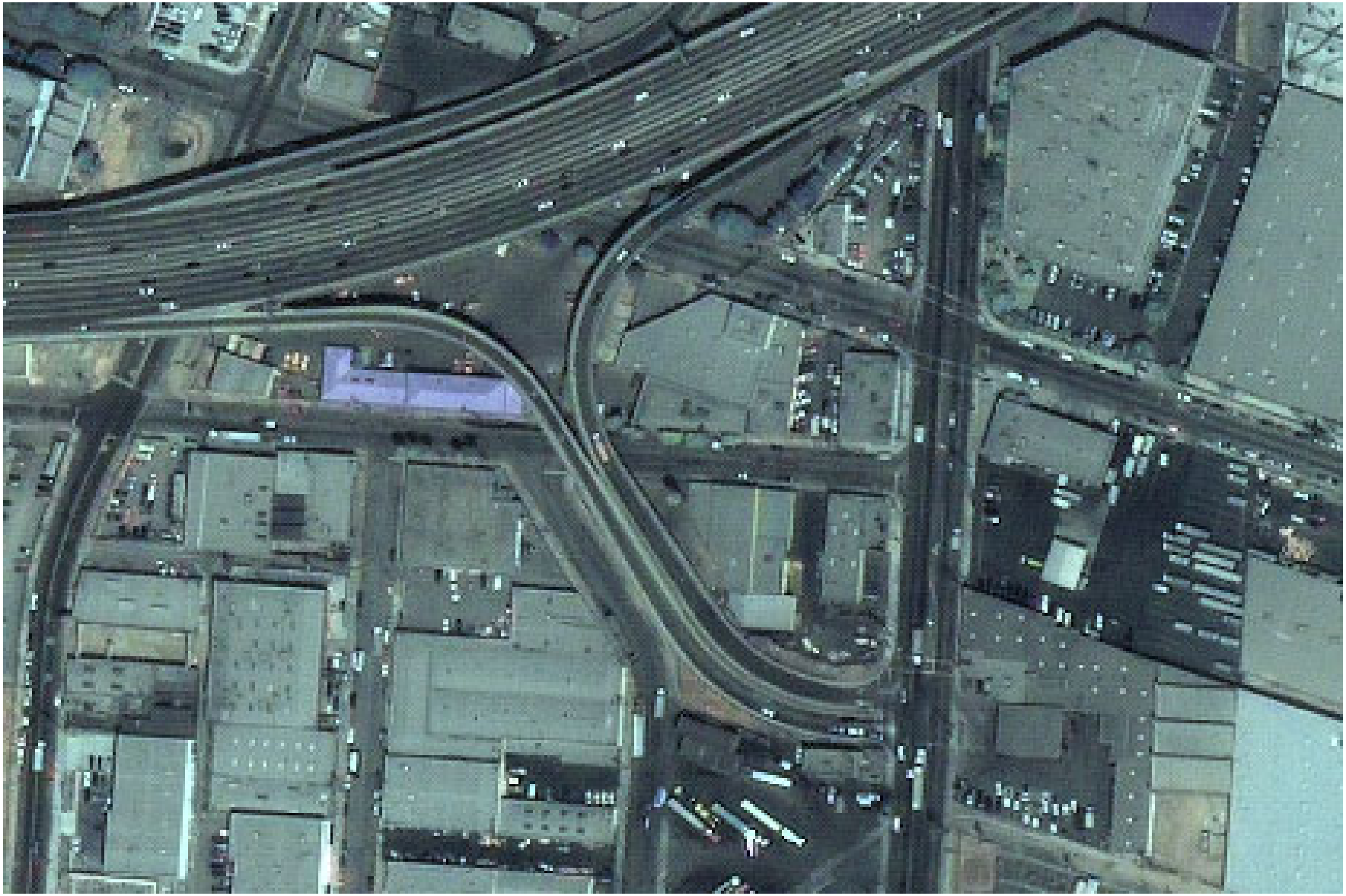
3-D Vector Overlay Washington Blvd.

3-D Vector Overlay Washington Blvd Detail

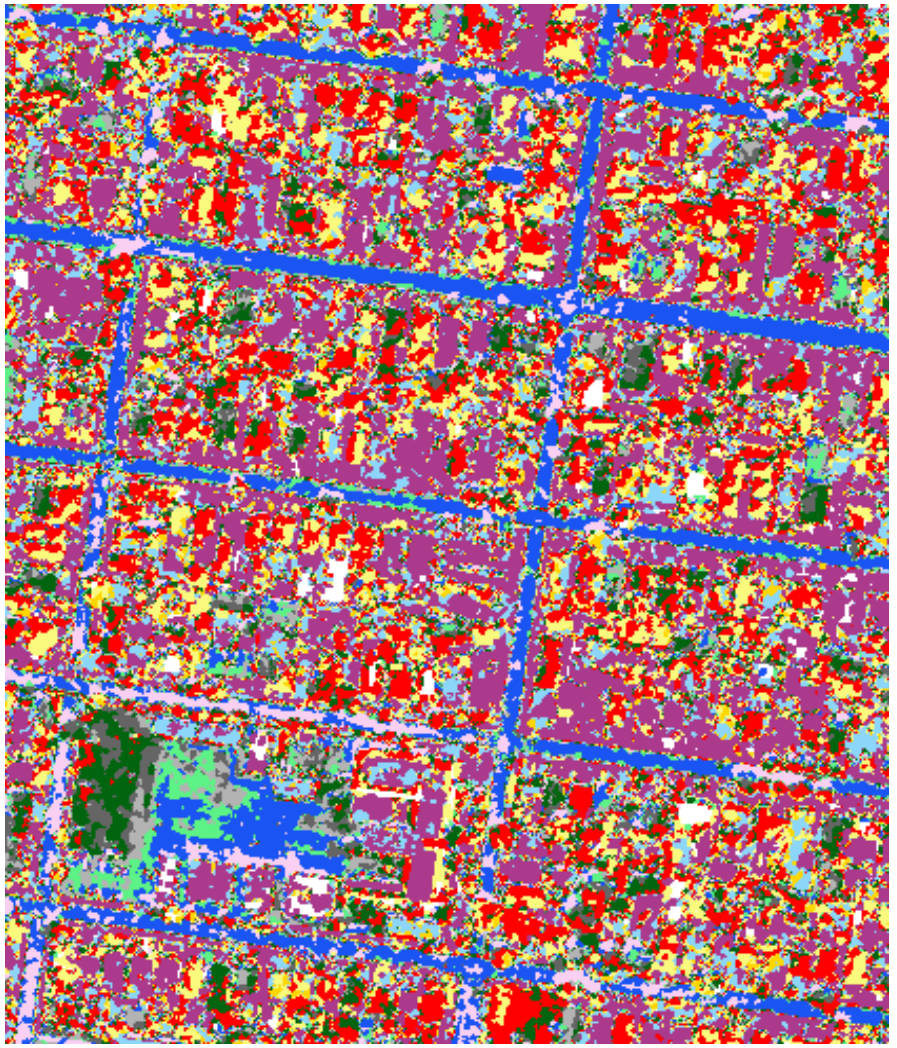


Alameda St. & I-110 Freeway (6” Airphoto)

Alameda St. & I-110 Freeway (1m IKONOS)

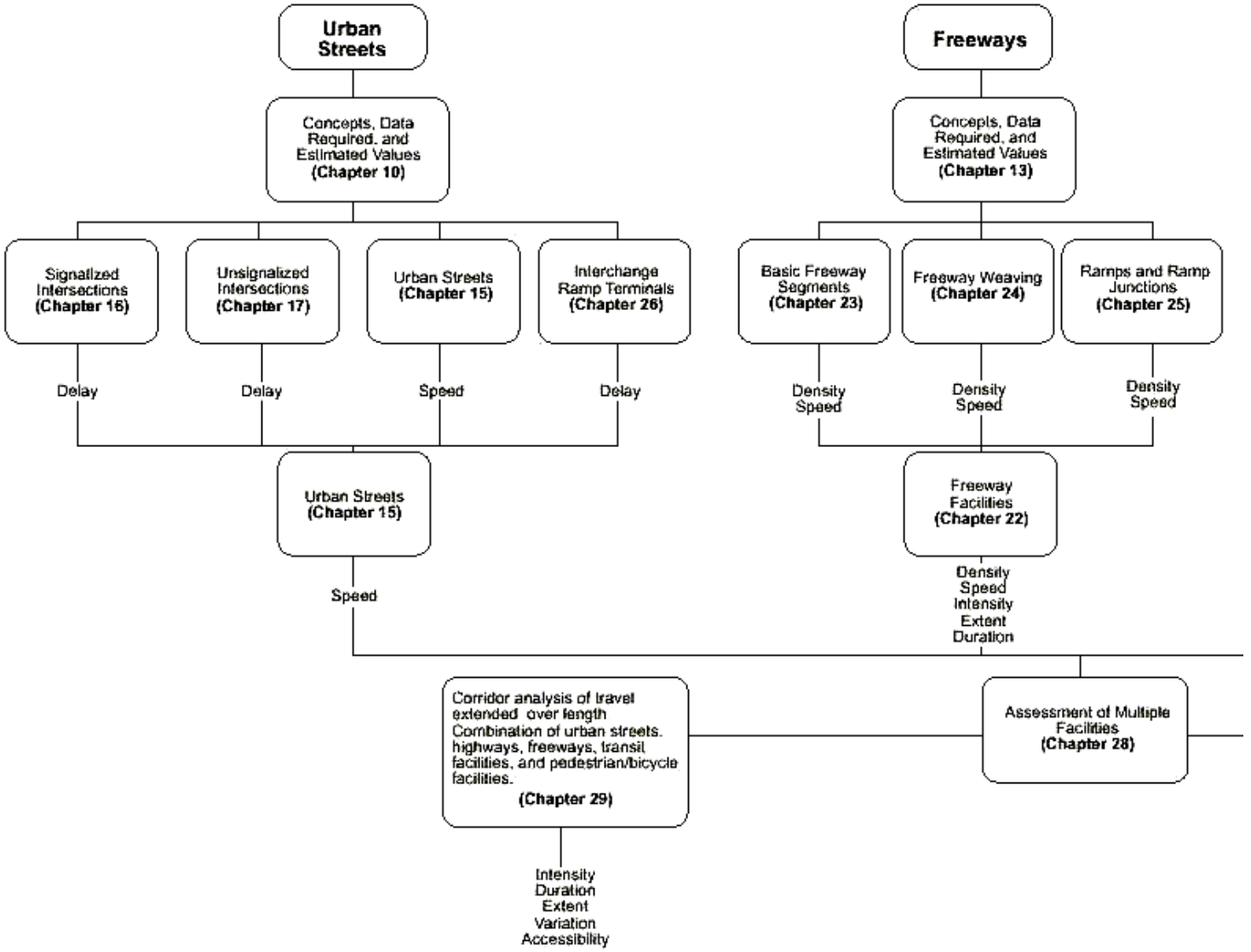


Washington Blvd (portion) Multispectral Classification



Washington Blvd (portion) Multispectral Classification Using *Feature Analyst*

Structure of the Highway Capacity Model (HCM2000)



Conclusions

- IKONOS geometric accuracy of *Geo* product can be corrected in low relief urban settings with a few GCPs to 1:24K map accuracy (7m)
- Resampled IKONOS multispectral imagery (16m, 12m, 8m) identifies urban land cover types with a standard Bayesian Classifier.
- Development of an ISH (intensity/saturation/hue) transformation of IKONOS MSS 4m and Pan 1m data supports multispectral classification.
- Successful Multispectral Classification of 1m Color IKONOS Requires Classifiers with Foveal Vision/Texture Analysis (e.g., *Feature Analyst*)
- Landcover Classes Supporting the Highway Capacity Manual (road types, predominant land use adjacent to an arterial) can be developed and interfaced as vector products in a GIS.